GRAVITY GRADIENT STABILIZATION SYSTEM for the

ADVANCED TECHNOLOGICAL SATELLITE

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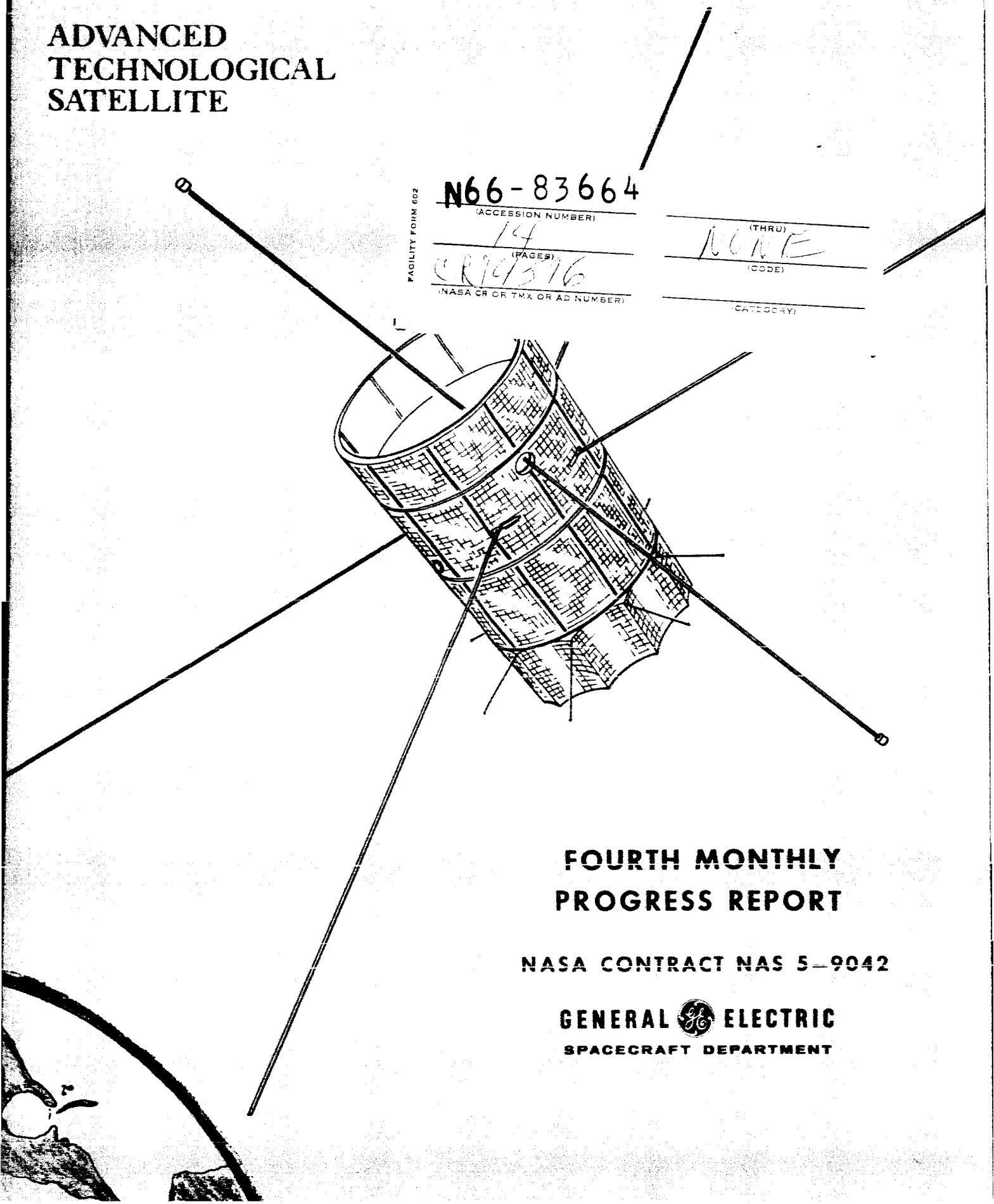

FOURTH MONTHLY PROGRESS REPORT

NASA CONTRACT NAS 5-9042

GENERAL ELECTRIC
SPACECRAFT DEPARTMENT

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GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE ADVANCED TECHNOLOGICAL SATELLITE

FOURTH MONTHLY PROGRESS REPORT

1 October to 31 October 1964

Contract No. NAS 5-9042

For The
National Aeronautics and Space Administration
Goddard Space Flight Center

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1.0 INTRODUCTION

This report documents the fourth month of progress since the inception of NASA Contract 5-9042 between the National Aeronautics and Space Administration and the Spacecraft Department of the General Electric Company leading to the design of those components and subsystems that make up the Advanced Technological Satellite Gravity Gradient Stabilization System. As required by the contract, this is a Type I report intended to inform management personnel of progress made during the reporting period from October 1, 1964 to October 31, 1964.

The Gravity Gradient Stabilization System is applied to three vehicles: one at a 6000-nautical mile inclined orbit, and two at synchronous-equatorial. The objective of the experiment at 6000 nm is to verify a previously developed mathematical model so that model can be employed for the design and dynamic performance predictions of gravity gradient stabilized vehicles at other altitudes and conditions. It is also an objective to demonstrate compatibility between gravity gradient stabilization systems and other equipments, such as communication, meteorological, etc.

2.0 WORK PERFORMED

The work performed during this reporting period includes a continuation of the effort toward the derivation of equations for the mathematical model, and further definition of the hardware for the gravity gradient stabilization and attitude sensing functions.

The system of coordinate frames that has been established for conversion from vehicle axes to those of the stabilization system was published in the First Quarterly Report, GE Document 64SD4361, dated 16 October 1964. Formalization of equations to describe the attitude dynamics of the ATS vehicle proceeded throughout the period on a schedule to ensure completion of the mathematical model within contract requirements.

Expansion of MAGGE inversion maneuver studies was accomplished to include characteristics of thrust build-up and decaying when using subliming rockets. Techniques are under consideration for the use of mechanical and fluid flywheels.

General Electric published our understanding of the latest vehicle interface drawing in the Fourth Monthly Interface Report, GE Document No. 64SD4365, dated 2 November 1964. The drawing shows the space allocation assigned by the Hughes Aircraft Company for the stabilization Booms, Damper, and Attitude Sensing Components. The Interface Document also contains the October report of weight and power requirements, and a telemetry command list.

2.1 Boom System

The X-booms were located so that the plane of the booms would pass through the vehicle combined center of pressure/center of mass. Hughes Aircraft and General Electric are in agreement of the X-booms location, but difficulties have been encountered in implementing the design.

A damper boom layout was made that revealed interference with the solar skirt on the vehicle. This problem was communicated to NASA for clarification.

2.2 Combination Passive Damper

Informal presentations were made to NASA representatives to justify the complex mechanism required to perform the clutching operation. Methods discussed to simplify the mechanism would also limit the damper functions. Several suggested layouts have since been prepared in response to a technical officer request for another look at the problem of clutch complexity. The major objectives of this effort have been:

1. Reducing complexity of the clutching mechanism by elimination of some requirements
2. Use of a "bistable clutch"
3. Reduction in the number of moving parts
4. Improve overall damper reliability

2.3 Attitude Sensing System

Investigations were made into the generally greater power and weight requirements of the slow scan system for the TV camera than had been allocated. Final decisions will be based on a better definition of the system requirements for frame rates and establishment of a use factor for the TV system.

A search continued during the month for the optimum method of data reduction of TV information. Three methods are under consideration; the technical aspects of the optimum method will be reported in the Second Quarterly Report.

A mock up of the RF Attitude Sensor was completed by the Radio Guidance Operation (RGO) of the General Electric Company during the month. Further design efforts are presently awaiting direction by NASA.

Construction of the breadboard of the Power Control Unit was continued. Additional commands were requested from NASA. Circuits are being incorporated into the breadboard to process these new ccmmands. A redundant provision is incorporated for all critical commands in the PCU.

3.0 SCHEDULE

Components requiring electronic piece parts have fallen behind schedule, primarily because of late definition of the Hughes Qualified Parts list. Where the approved lists are available, the vendors are requoting the price of the component. The new schedules based on HAC parts will be incorporated into the PERT computer runs and a new schedule date will be available by Mid-November.

The Boom systems are on schedule.

The combined passive damper is presently behind schedule. This schedule will be re-estimated as soon as the NASA/GE design reviews are complete and a design concept is accepted.

It is estimated that the delivery of the thermal and dynamic models (T_2 and T_3) will be February 22, 1965 (one week late) and T_4 will be May 28, 1965 (four weeks late). All other deliverable hardware is on schedule. Effort is continuing to improve the estimated completion dates for T_2, T_3 and T_4.

4.0 RELIABILITY

The reliability plan was up-dated during October to include better definitions for the use of parts, materials, and processes in the ATS Program. A further definition of the parts qualification program was prepared that includes work statements, a schedule, manpower estimates, and part procurement costs.

A comparative analysis was conducted for the Combination Passive Damper. One result was a request for the provision of a back-up operating mode in the event of a failure to the main clutch mechanism. A design is in process that will incorporate this back-up feature.

5.0 FUNDING

Expenditures and commitments for this period ending October 25, 1964, including open material requests, is $502,500 with a total from contract inception of $771,300.

6.0 MANPOWER

As of October 25, 1964, manpower has built up to 70 equivalent men/month as allowed per contract.

7.0 WORK PLANNED

It is anticipated that design effort during November will be consolidated because of the more definitive interface agreements with the vehicle contractor and the NASA decision to use a combination damper. These agreements will enable ordering activities to go forward in all system areas. Several work statements have been up-dated in anticipation of contract negotiations between NASA and GE.

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